

IN THE CLAIMS:

Please cancel claims 2, 9, and 17 without prejudice or disclaimer, amend claims 1, 3-8, 10-16, and 18-20, and add new claims 21-32 as follows:

1. (Currently Amended) A fabricating method of a semiconductor integrated circuit device comprising forming a ~~ruthenium~~ bottom electrode of a capacitor with high-k material on a semiconductor substrate by a chemical vapor deposition method in a sub-atmospheric pressure using an organoruthenium compound as a precursor, which includes steps of:
 - ~~a first step of~~ providing the semiconductor substrate in a deposition chamber[[],];
 - increasing a temperature of the semiconductor substrate in the chamber up to a desired temperature;
 - ~~a second step of~~ separately supplying the precursor and an oxidation gas into the deposition chamber to form a ruthenium film for the bottom electrode with a desired thickness on the heated semiconductor substrate, said oxidation gas being separately supplied to said deposition chamber by a supplying system different from a precursor supplying system and only during when the precursor being supplied; and
 - ~~a third step of~~ stopping the supply of the precursor and said oxidation gas; and decreasing the temperature of the semiconductor substrate;~~;~~ and
wherein said bottom electrode essentially consists of ruthenium.
2. (Cancelled)
3. (Currently Amended) The fabricating method of a semiconductor integrated circuit device according to claim 1, wherein the ruthenium electrode forming method further includes a step of introducing a balance gas in addition to a carrier gas so as to keep a pressure in the deposition chamber constant through all of the other steps.
4. (Currently Amended) The fabricating method of a semiconductor integrated circuit device according to claim 1, ~~whereby~~ during the second supplying step, the oxidation gas and an inert gas are supplied such that a oxygen partial pressure created by the oxidation gas in the deposition chamber is 0.1 Torr or less such that an amount of

oxygen adsorption onto a surface of the semiconductor substrate is set to a minimum amount required for de-composing the precursor.

5. (Currently Amended) The fabricating method of a semiconductor integrated circuit device according to claim 1, ~~whereby~~ during the second supplying step, the oxidation gas, an inert gas, and a solvent gas are supplied such that the oxygen partial pressure in the deposition chamber is 0.5 Torr or less such that the amount of oxygen adsorption onto the surface of the semiconductor substrate is set to a minimum amount required for de-composing the precursor.

6. (Currently Amended) The fabricating method of a semiconductor integrated circuit device according to claim 1, ~~whereby~~ during the second supplying step, the precursor of an organoruthenium compound is dissolved in a solvent as the precursor, and

wherein the ruthenium electrode forming method further includes a step of supplying the oxidation gas and an inert gas such that the oxygen partial pressure in the deposition chamber is 0.1 Torr or less thereby setting the amount of oxygen adsorption onto the surface of the semiconductor substrate to a minimum amount required for the decomposition of the precursor thereby increasing the amount of oxygen adsorption onto the surface of the semiconductor substrate and shortening a growth time of the electrode.

7. (Currently Amended) The fabricating method of a semiconductor integrated circuit device according to claim 1, ~~whereby~~ during the second supplying step, a diluted precursor of an organoruthenium compound is dissolved in a solvent as the precursor, and

wherein the ruthenium electrode forming method further includes a step of supplying the oxidation gas, an inert gas, and a solvent gas such that the oxygen partial pressure in the deposition chamber is 0.5 Torr or less thereby setting the amount of oxygen adsorption onto the surface of the semiconductor substrate to a minimum amount required for the decomposition of the precursor thereby increasing the amount of oxygen adsorption onto the surface of the semiconductor substrate and shortening a growth time of the electrode.

8. (Currently Amended) The fabricating method of a semiconductor integrated circuit device according to claim 1, ~~whereby the second~~ supplying step further comprising a step of controlling the amount of oxygen adsorption onto the surface of the semiconductor substrate by the amount of a supplied vaporized solvent gas.
9. (Cancelled)
10. (Currently Amended) The fabricating method of a semiconductor integrated circuit device according to claim 1, wherein the organoruthenium compound comprises at least one of
bis-(cyclopentadienyl)ruthenium $[\text{Ru}(\text{C}_5\text{H}_5)_2]$,
bis-(methylcyclopentadienyl)ruthenium $[\text{Ru}(\text{CH}_3\text{C}_5\text{H}_4)_2]$,
bis-(ethylcyclopentadienyl)ruthenium $[\text{Ru}(\text{C}_2\text{H}_5\text{C}_5\text{H}_4)_2]$,
tris-(dipivaloylmethanate)ruthenium $[\text{Ru}(\text{C}_{11}\text{H}_{19}\text{O}_2)_3]$, and $\text{Ru}(\text{OD})_3$.
11. (Currently Amended) The fabricating method of a semiconductor integrated circuit device according to claim 1, wherein the solvent for dissolving the organoruthenium compound to comprises at least one of methanol, ethanol, 1-propanol, 2-propanol, isobutyl alcohol, 1-butanol, 2-butanol, diethyl ether, diisopropyl ether, octane, tetrahydropuran, tetrahydropyran, 1,4-dioxane, acetone, methyl ethyl ketone, and toluene.
12. (Currently Amended) A fabricating method of a semiconductor integrated circuit device according to claim 1, further comprising:
~~forming a capacitor bottom electrode made of a ruthenium metal film on a semiconductor substrate by a chemical vapor deposition method in a sub-atmospheric pressure using an organoruthenium compound as a precursor and oxygen; and~~
after forming the bottom electrode, immediately ~~thereafter~~ performing annealing at not less than a formation temperature of the bottom electrode made of ~~said ruthenium metal film~~ in a reducing atmosphere containing hydrogen thereby removing oxygen introduced into a surface of said ruthenium metal film when said ruthenium metal film is formed therefrom and inhibiting deformation of crystal grains of the bottom electrode ~~made of said ruthenium metal film~~ in the annealing step

during or after forming a high-k capacitor insulator.

13. (Currently Amended) The fabricating method of a semiconductor integrated circuit device according to claim 12, wherein the annealing temperature in the reducing atmosphere is not more than the annealing temperature for crystallization of the capacitor insulator.
14. (Currently Amended) The fabricating method of a semiconductor integrated circuit device according to claim 12, wherein the temperature at which the deformation of crystal grains of the bottom electrode of ruthenium is inhibited is 800 °C or less.
15. (Currently Amended) The fabricating method of a semiconductor integrated circuit device according to claim 12, wherein a grain size of the crystal grains of the bottom electrode of ruthenium ranges from 30 nm to 60 nm.
16. (Currently Amended) The fabricating method of a semiconductor integrated circuit device according to claim 1, wherein the bottom electrode of ruthenium of a capacitor with high-k material is formed on the semiconductor substrate, and immediately thereafter annealing is performed at not less than the formation temperature of the bottom electrode of ruthenium in an inert atmosphere or a reducing atmosphere thereby inhibiting deformation of crystal grains of the bottom electrode of ruthenium in the annealing step during or after capacitor insulator formation.
17. (Cancelled)
18. (Currently Amended) The fabricating method of a semiconductor integrated circuit device according to claim 1, wherein the oxidation gas comprises at least one of O₂, N₂O, H₂O, NO₂, and O₃.
19. (Currently Amended) The fabricating method of a semiconductor integrated circuit device according to claim 4, wherein the inert gas comprises at least one of N₂, He, Ar, Ne, and Xe.

20. (Currently Amended) The fabricating method of a semiconductor integrated circuit device according to claim 12, whereby the annealing step is performed at a temperature lower than a crystallization temperature of the high-k capacitor.
21. (New) A fabricating method of a semiconductor integrated circuit device comprising forming a top electrode of a capacitor with high-k material on a semiconductor substrate by a chemical vapor deposition method in a sub-atmospheric pressure using an organoruthenium compound as a precursor, which includes steps of:
- providing the semiconductor substrate in a deposition chamber;
 - increasing a temperature of the semiconductor substrate in the chamber up to a desired temperature;
 - separately supplying the precursor and an oxidation gas into the deposition chamber to form a ruthenium film for the top electrode with a desired thickness on the heated semiconductor substrate, said oxidation gas being separately supplied to said deposition chamber by a supplying system different from a precursor supplying system; and
 - stopping the supply of the precursor and said oxidation gas; and
 - decreasing the temperature of the semiconductor substrate,
- wherein said top electrode essentially consists of ruthenium, and
- said oxidation gas is supplied to said deposition chamber when the substrate temperature is increased, when the precursor is supplied, and when the substrate temperature is decreased.
22. (New) The fabricating method of a semiconductor integrated circuit device according to claim 21, wherein the ruthenium electrode forming method further includes a step of introducing a balance gas in addition to a carrier gas so as to keep a pressure in the deposition chamber constant through all of the other steps.
23. (New) The fabricating method of a semiconductor integrated circuit device according to claim 21, during the supplying step, the oxidation gas and an inert gas are supplied such that a oxygen partial pressure created by the oxidation gas in the deposition chamber is 0.1 Torr or less such that an amount of oxygen adsorption onto a surface of the semiconductor substrate is set to a minimum amount required for de-composing

the precursor.

24. (New) The fabricating method of a semiconductor integrated circuit device according to claim 21, during the supplying step, the oxidation gas, an inert gas, and a solvent gas are supplied such that the oxygen partial pressure in the deposition chamber is 0.5 Torr or less such that the amount of oxygen adsorption onto the surface of the semiconductor substrate is set to a minimum amount required for de-composing the precursor.
25. (New) The fabricating method of a semiconductor integrated circuit device according to claim 21, during the supplying step, the precursor of an organoruthenium compound is dissolved in a solvent as the precursor, and
wherein the top electrode forming method further includes a step of supplying the oxidation gas and an inert gas such that the oxygen partial pressure in the deposition chamber is 0.1 Torr or less thereby setting the amount of oxygen adsorption onto the surface of the semiconductor substrate to a minimum amount required for the decomposition of the precursor thereby increasing the amount of oxygen adsorption onto the surface of the semiconductor substrate and shortening a growth time of the electrode.
26. (New) The fabricating method of a semiconductor integrated circuit device according to claim 21, during the supplying step, a diluted precursor of an organoruthenium compound is dissolved in a solvent as the precursor, and
wherein the top electrode forming method further includes a step of supplying the oxidation gas, an inert gas, and a solvent gas such that the oxygen partial pressure in the deposition chamber is 0.5 Torr or less thereby setting the amount of oxygen adsorption onto the surface of the semiconductor substrate to a minimum amount required for the decomposition of the precursor thereby increasing the amount of oxygen adsorption onto the surface of the semiconductor substrate and shortening a growth time of the electrode.
27. (New) The fabricating method of a semiconductor integrated circuit device according to claim 21, during increasing the substrate temperature, oxygen partial pressure in the

deposition chamber is 0.5 Torr or less.

28. (New) The fabricating method of a semiconductor integrated circuit device according to claim 21, the supplying step further comprising a step of controlling the amount of oxygen adsorption onto the surface of the semiconductor substrate by the amount of a supplied vaporized solvent gas.
29. (New) The fabricating method of a semiconductor integrated circuit device according to claim 21, wherein the organoruthenium compound comprises at least one of
bis-(cyclopentadienyl)ruthenium $[\text{Ru}(\text{C}_5\text{H}_5)_2]$,
bis-(methylcyclopentadienyl)ruthenium $[\text{Ru}(\text{CH}_3\text{C}_5\text{H}_4)_2]$,
bis-(ethylcyclopentadienyl)ruthenium $[\text{Ru}(\text{C}_2\text{H}_5\text{C}_5\text{H}_4)_2]$,
tris-(dipivaloylmethanate)ruthenium $[\text{Ru}(\text{C}_{11}\text{H}_{19}\text{O}_2)_3]$, and $\text{Ru}(\text{OD})_3$.
30. (New) The fabricating method of a semiconductor integrated circuit device according to claim 21, wherein the solvent for dissolving the organoruthenium compound to comprises at least one of methanol, ethanol, 1-propanol, 2-propanol, isobutyl alcohol, 1-butanol, 2-butanol, diethyl ether, diisopropyl ether, octane, tetrahydropuran, tetrahydropyran, 1,4-dioxane, acetone, methyl ethyl ketone, and toluene.
31. (Currently Amended) The fabricating method of a semiconductor integrated circuit device according to claim 21, wherein the oxidation gas comprises at least one of O_2 , N_2O , H_2O , NO_2 , and O_3 .
32. (New) The fabricating method of a semiconductor integrated circuit device according to claim 23, wherein the inert gas comprises at least one of N_2 , He, Ar, Ne, and Xe.